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G02B 27/18

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G2J JB7M

(56) Documents Cited
EP 0633491 A1 WO 92/16871 A1 US 5274406 A

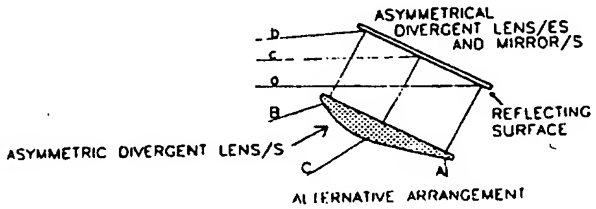
(58) Field of Search
UK CL (Edition N) G2J JB7M JVS J41 , H4F FCW
INT CL^6 G02B , G03B , H04N

All about distortion compensation.

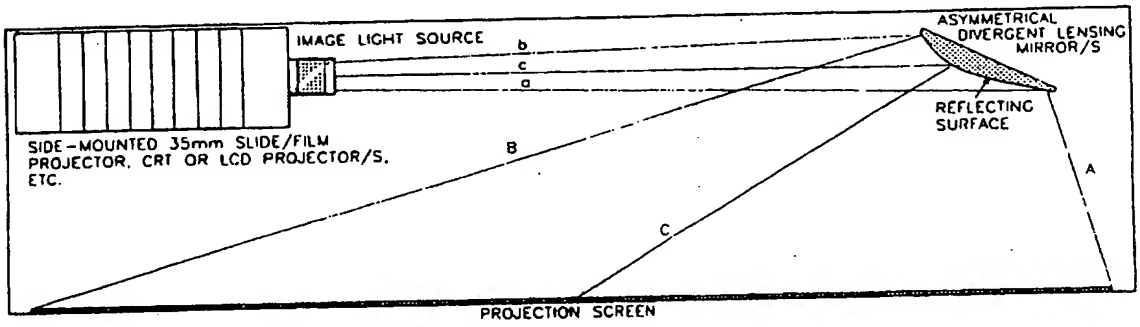
(54) Asymmetric divergent projection system

(57) The asymmetric divergent projection system has a colour or monochrome film, CRT, LCD or similar image projection device, an asymmetrical divergent lensing mirror/s or lens/es and an image projection screen.

The image is focused onto the screen using an asymmetrical divergent lensing mirror/s or lens/es whose asymmetric convex shape expands the image, optically compensating for the geometric image distortion caused by the varying focal length (A ⇔ B) occurring with the mirror/s being placed off screen-centre to project the image across the full front area of the unit's housing. Distortion compensation is achieved by graduating the angle of reflection, or refraction for a lens, over surface of the divergent mirror or lens such that the image is equally projected across the surface of the screen to match the optical paths shown as B, C and A.

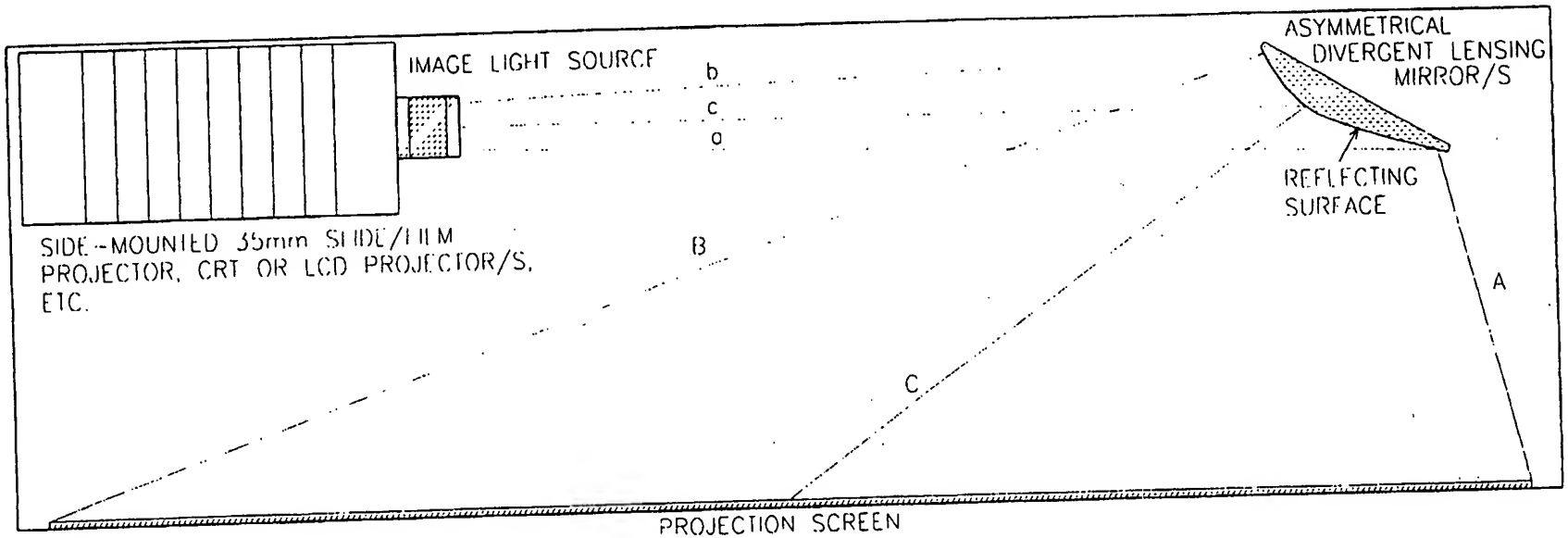


ALTERNATIVE ARRANGEMENT

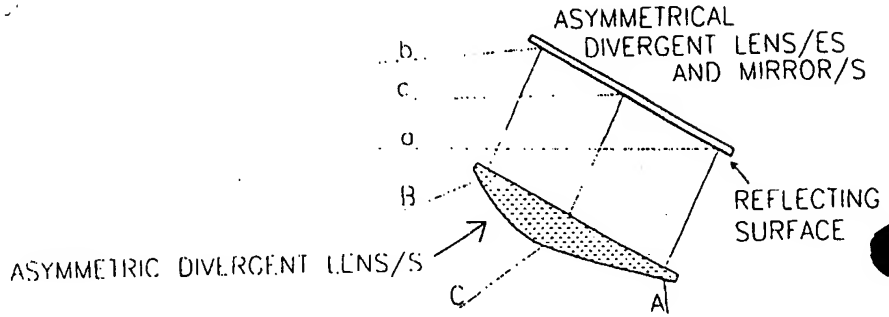


PLAN VIEW

GB 2 298 497 A



PLAN VIEW



ALTERNATIVE ARRANGEMENT

ASYMMETRIC DIVERGENT PROJECTION SYSTEM

This invention relates to an image display device.

Typical image display devices include domestic televisions and computer monitors, utilising CRT or flat panel LCD, Plasma or FED technologies, etc., and rear-screen and film projectors. Images may be produced using several different techniques. For example, the CRT television image is produced by scanning the image onto the rear of a phosphor coated screen within an electron tube, causing the phosphor to emit light whenever it is irradiated by the electron beam. Rear-screen and film projectors project light onto a screen, either from behind the screen or at a much greater distance from in front of the screen.

However, all of these display devices are either very large, in terms of depth and weight (CRTs and rear-screen projectors), unsuited to use in well lit areas (film projectors) or currently have too small an image area (flat panel devices).

According to the present invention there is presented an asymmetric divergent projection system comprising an image light source/s, asymmetric divergent lensing mirror/s or separate mirror/s and asymmetric divergent lens/es, and an image projection screen, where the projection system's parts - image light source, mirror/s, etc. - can be placed behind and largely within the area of the projection screen such that the image is projected onto the screen as shown in the accompanying drawing, titled "ASYMMETRIC DIVERGENT PROJECTION DISPLAY", no. DH-19-001-01C dated 8.1.95, such projection arrangement allowing the projection screen to be as large or very nearly as large as the unit's outer housing, and also minimising the unit's depth.

A specific embodiment of the invention will now be described by way of an example with reference to the accompanying drawing in which a rear-screen asymmetric divergent projection system (a.d.p.s.) is shown in plan view.

Referring to the drawing, titled "ASYMMETRIC DIVERGENT PROJECTION DISPLAY", no. DH-19-001-01C dated 8.1.95, the example asymmetric divergent projection system (a.d.p.s.) shown comprises a film, CRT, LCD or similar device image projector, be it either colour or monochrome in type, an asymmetrical divergent lensing mirror/s, or mirror/s and lens/es, and an image projection screen. The image is focused onto the screen by the asymmetrical divergent lensing mirror/s, or mirror/s and lens/es, whose asymmetric convex shape expands the image optically compensating for the geometric image distortion caused by the varying focal length (A $\Leftrightarrow$B) which occurs when the mirror/s is/are placed substantially off-screen-centre in order to achieve a reduction in the dimensions of the projection display system unit and an increased display screen size. Compensation for this distortion is achieved by graduating the angle of reflection, or refraction for a lens, over surface of the divergent mirror or lens such that the image is equally projected across the surface of the screen, such as to match optical paths shown as B, C and A.

CLAIMS

Terminology:

Focal length compensation	With reference to drawing, titled "ASYMMETRIC DIVERGENT PROJECTION DISPLAY", DH-19-001-01C, where an image is reflected onto the surface of a screen which is at a convergent angle to that of the mirror such that the distance from one side of the mirror (B) to the screen is much greater than that of the other side (A), it can be said that the image projected has a variable focal length (A⇔B), which, without compensation, would cause the image to suffer geometric distortion similar to that caused by the shadow cast by the setting sun.
Asymmetric divergent lensing-mirror/lens	A reflective surface or lens contoured to magnify (diverge) an image using focal length compensation designed to correct image distortion caused by off screen-centre mirror placement.
Divergent projection	Where an image is projected such that it diverges from the point of origin of the light source, lens or reflecting surface, thereby increasing in magnitude as the light travels outwards.

Claims

1. An asymmetric divergent projection system comprising an image light source/s, asymmetric divergent lensing mirror/s or separate mirror/s and asymmetric divergent lens/es, and an image projection screen, where the projection system's parts - image light source, mirror/s, etc. - can be placed behind and largely within the area of the projection screen such that the image is projected onto the screen as shown in the accompanying drawing, titled "ASYMMETRIC DIVERGENT PROJECTION DISPLAY", no. DH-19-001-01C dated 8.1.95, such projection arrangement allowing the projection screen to be as large or very nearly as large as the unit's outer housing, and also minimising the unit's depth.
2. An asymmetric divergent projection system as claimed in Claim 1 wherein an asymmetric divergent lensing mirror, or separate mirror/s and asymmetric divergent lens/es, or multiples of the same as in the case of the use of separate Red, Green and Blue light sources to achieve colour, produces an enlarged and variable focal length compensated image on a screen.
3. An asymmetric divergent projection system as claimed in Claim 1 or Claim 2 wherein an asymmetric divergent lensing mirror/s or separate mirror/s and asymmetric divergent lens/es is/are used to provide a reduced volume display device.
4. An asymmetric divergent projection system as claimed in Claims 1, 2 or 3 wherein an asymmetric divergent lensing mirror/s or separate mirror/s and asymmetric divergent lens/es is/are used to produce an enlarged image display with a reduced focal length as when compared to a projection system using a non-divergent lens/mirror system.
5. An asymmetric divergent projection system substantially as described herein with reference to the accompanying drawing, titled "ASYMMETRIC DIVERGENT PROJECTION DISPLAY", no. DH-19-001-01C dated 8.1.95.

Amendments to the claims have been filed as follows

1. Image projecting apparatus comprising a projecting lensing means for projecting an image of an illuminated object, a screen, and reflecting means for reflecting light from the projecting lensing means onto the screen, wherein the reflecting means is positioned off-centre with respect to the screen, and asymmetric diverging lensing means are provided for magnifying further the image reflected by the reflecting means onto the screen, the lensing power of the diverging lensing means varying across the area thereof, such that for each point on the diverging lensing means the combined focal length of the projecting lensing means and diverging lensing means is adjusted according to the length of the optical path between the projecting lensing means and the screen via that point, thereby to reduce optical distortion of the image on the screen.

2. Image projecting apparatus as claimed in claim 1 wherein the reflecting means and diverging lensing means comprise an asymmetrical diverging lensing mirror.

3. Image projecting apparatus as claimed in claim 1 wherein the reflecting means comprises a substantially planar mirror, and the diverging lensing means comprises an asymmetrical diverging lens positioned in

juxtaposition with the planar mirror.

4. Image projecting apparatus as claimed in claim 2 or claim 3 wherein the asymmetric mirror or lens has an asymmetric convex shape.

5. Image projecting apparatus as claimed in claim 2, claim 3 or claim 4, wherein the angle of reflection or refraction for the asymmetric mirror or lens varies across the area of the mirror or lens such that the image is projected equally across the screen.

6. Image projecting apparatus as claimed in any preceding claim wherein the divergence of the beam emerging from the projecting means is about 10^{o}, and the divergence of the reflected beam is about 85^{o}.

7. Image projecting apparatus as claimed in any preceding claim wherein the projecting lensing means comprises a CRT, flat panel LCD or a film projector.

8. Image projecting apparatus comprising separate projecting lensing means and corresponding reflecting means and diverging means respectively for red, green and blue illuminated objects, the three images being reflected onto the screen to form a colour image.

9. Image projecting apparatus as claimed in any preceding claim wherein the projecting means, reflecting means and diverging means are positioned substantially within an area which is coterminous with the screen.

10. Image projecting apparatus as claimed in any preceding claim further comprising a housing of rectangular cross-section wherein the screen occupies substantially the entire area of one face of the housing.

11. Image projecting apparatus substantially as hereinbefore described with reference to and as illustrated in one or other of the figures of the accompanying drawings.

Patents Act 1977 6
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

(i) UK Cl (Ed.N) G2J (J41, JVS, JB7M); H4F (FCW)

(ii) Int Cl (Ed.6) G03B, H04N, GO2B

Search Examiner
MR C ROSS

Date of completion of Search
22 NOVEMBER 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-5

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0633491 A1	(SHARP)	1 at least
X	WP 92/16871 A1	(SEIKO EPSON) see especially Figure 38(A)	1 at least
X	US 5274406	(ASAHI)	1 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).